Human Rabies

1. DISEASE REPORTING

A. Purpose of Reporting and Surveillance

1. To assist in the diagnosis of human cases of rabies.
2. To identify persons potentially exposed to a human rabies patient and provide counseling about postexposure prophylaxis (PEP).
3. To offer PEP to others who may have been exposed to the same source as the patient.

B. Legal Reporting Requirements

1. Health care providers: **immediately notifiable to local health jurisdiction.**
2. Hospitals: **immediately notifiable to local health jurisdiction.**
3. Laboratories: **immediately notifiable to local health jurisdiction**; specimen submission required.
4. Local health jurisdiction: notifiable to DOH Communicable Disease Epidemiology Section (CDES) within 7 days of case investigation completion or summary information required within 21 days.

C. Local Health Jurisdiction Investigation Responsibilities

1. Begin investigation immediately.
2. Facilitate transport of specimens to the Centers for Disease Control and Prevention. Please call CDES prior to submitting specimens (206-418-5500).
3. Identify potentially exposed persons and make postexposure prophylaxis (PEP) recommendations.
4. Report all *confirmed* cases to CDES (see definitions below). Complete the rabies case report form (http://www.doh.wa.gov/notify/forms/rabies.pdf) and enter the data into the Public Health Issues Management System (PHIMS).

2. THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

The disease is caused by the rabies virus (Family *Rhabdoviridae,* genus *Lyssavirus*), a single stranded RNA virus. In the United States, there are several rabies virus variants (strains) circulating among reservoir hosts including raccoon, fox, skunk, and a variety of bat variants.

B. Description of Illness

Rabies is a rapidly progressive, acute viral encephalomyelitis. Initial symptoms may include headache, fever, and malaise. Initial neurologic symptoms may include parasthesias or pain often affecting the limb or site where the inoculation occurred and subtle changes in personality. Later neurologic symptoms can include seizures, hypersalivation, hydrophobia, delirium, agitation, and paralysis. Neurological

deterioration is rapid; death is often due to cardiac arrest or respiratory paralysis. Death occurs an average of 18 days after the onset of symptoms.

For more information on animal rabies and exposure assessment, please see the Surveillance and Reporting Guidelines for Animal Bites and Rabies Post-Exposure Prophylaxis found at: http://www.doh.wa.gov/notify/guidelines/pdf/rabiesPEP.pdf

C. Human Rabies in Washington State

Two human cases of rabies have been reported in Washington in the past 50 years, one in 1995 and one in 1997 (MMWR 1997;46(33):770–4). Both were due to bat rabies variants.

D. Reservoirs

In Washington, Oregon, and Idaho, bats are the primary reservoir species. In other parts of the United States, skunks, raccoons and foxes are important reservoirs (in addition to bats). In some parts of the world, dogs and other carnivores may be important reservoirs.

Bats are the only known reservoir for rabies in Washington State and rabid bats are found throughout the state. The percentage of bats in the wild that are infected with rabies is very low (less than 1%), however 5–10% of the sick and injured bats submitted for testing in Washington are rabid (see Table 1). Rabies has also occurred recently in animals other than bats (Table 2).

Bats are also the primary reservoir for rabies in Oregon, Idaho, and British Columbia. However, during 2000–2007, rabid non-bat animals were detected in these states and province. Oregon identified six rabid foxes with bat-variant rabies during 2000–2007. Idaho detected a rabid bobcat in 2001 and a rabid skunk in 2004 both with bat-variant rabies. British Columbia found 4 skunks in a park in Vancouver in 2004 and a cat in 2007 all infected with bat-variant rabies. This clearly demonstrates that rabies in bats spills over to other wild animals, as well as domestic animals.

Table 1: Rabid Bats Detected in WA, 2000–2007

Year	Rabid bats / Total no. bats tested (%)
2007	22/315 (7)
2006	15/273 (5)
2005	15/245 (6)
2004	20/311 (6)
2003	23/229 (10)
2002	12/186 (6)
2001	22/263 (8)
2000	23/330 (7)

Table 2: Rabid Non-Bat Animals and Rabies Strain Type in WA, 1986–2007

Year	Animal type (County)	Rabies Strain
2002	Cat (Walla Walla)	Bat-variant
1994	Llama (King)	Bat-variant
1992	Horse (Franklin)	Unknown
1987	Dog (Pierce)*	Unknown, but history of bat exposure

* infection was not confirmed at CDC

E. Modes of Transmission

Rabies may be transmitted when saliva or other potentially infectious material (central nervous system tissue) penetrates the skin or contaminates the mucosa of a susceptible mammal. Although person-to-person transmission of rabies has been confirmed only via corneal and organ transplantation, transmission through bites or other mucous membrane exposure is theoretically possible. In addition, four cases of rabies may have occurred as the result of exposure to large amounts of aerosolized rabies virus (e.g., exposure to millions of bats in a cave or through handling laboratory specimens). Rabies is not transmitted by contact with blood, urine or feces, by touching fur, or by being sprayed by a skunk. The virus becomes inactive with drying.

F. Incubation Period of Human Rabies

The incubation period of rabies in humans is typically 3 to 8 weeks but can range from 9 days to several years.

G. Period of Communicability

Rabies virus is present in saliva, CSF, and neurologic tissues of infected patients who are in the final (clinical) stage of disease.

Rabid dogs, cats and ferrets are considered communicable no more than 10 days prior to symptom onset. Little or nothing is known about how early communicability starts in other species, including humans.

H. Treatment

There is no proven effective treatment for rabies once clinical signs develop. "When a definitive diagnosis is obtained, primary health considerations should focus, at a minimum, on comfort care and adequate sedation of the patient in an appropriate medical facility. . . As new potential treatments become available, medical staff at specialized tertiary care hospitals might consider institution of an aggressive approach to experimental therapies, especially in confirmed cases in young healthy persons at an early stage of clinical disease, after in depth discussions and informed consent by the patient, family or legal representatives (http://www.mcw.edu/display/router.asp?DocID=11655). Parties authorized to give permission for such treatment also should be aware of the high probability for treatment failure, the anticipated expenses, and that in the rare instances of patient survival, the recovery might be associated with a variety of neurologic deficits requiring a lengthy period of rehabilitation (MMWR 2008;57:RR-3)."

For information regarding management of human rabies, please see: http://www.cdc.gov/RABIES/healthcare.html

3. CASE DEFINITIONS

A. Clinical description

Rabies is an acute encephalomyelitis that almost always progresses to coma or death within 10 days after the first symptom.

B. Laboratory criteria for diagnosis

1. Detection by direct fluorescent antibody of viral antigens in a clinical specimen (preferably the brain or the nerves surrounding hair follicles in the nape of the neck), or
2. Isolation (in cell culture or in a laboratory animal) of rabies virus from saliva, cerebrospinal fluid (CSF), or central nervous system tissue, or
3. Identification of a rabies-neutralizing antibody titer greater than or equal to 5 (complete neutralization) in the serum or CSF of an unvaccinated person.

C. Case classification (1997)

Confirmed: a clinically compatible case that is laboratory confirmed

D. Comment: Laboratory confirmation by all of the above methods is strongly recommended.

4. DIAGNOSIS AND LABORATORY SERVICES

A. Diagnosis

Rabies should be considered in patients with signs or symptoms of encephalitis or myelitis. The course of the illness, additional history such as potential exposures, and laboratory tests for other more common etiologies can determine if samples specific for rabies should be collected. All human rabies diagnostic testing will be preformed at CDC**. Health care providers who wish to test a patient for rabies should contact their local health jurisdictions who in turn will contact DOH.**

For information regarding specimen collection and tests performed at CDC see "Specimen Collection" section below.

B. Tests Available at PHL

All human rabies diagnostic testing will be preformed at CDC. Please call Communicable Disease Epidemiology Section (206) 418-5500 to arrange for testing.

See Animal Bites and Rabies Post-exposure Prophylaxis guidelines (http://www.doh.wa.gov/notify/guidelines/pdf/rabiesPEP.pdf) for information about testing animals for rabies.

C. Specimen Collection (the following information was accessed on April 30, 2008 from the CDC web site http://www.cdc.gov/RABIES/healthcare.html)

1. Patient History

The health care provider submitting specimens for human rabies testing needs to complete the CDC Patient Information Form (http://www.cdc.gov/RABIES/form_patient_history.html). This form must accompany any samples sent to the Rabies Laboratory at the CDC.

2. Antemortem Samples

All samples should be considered as potentially infectious. Test tubes and other sample containers must be securely sealed (tape around the cap will insure that the containers do not open during transit). If immediate shipment is not possible, samples should be stored frozen at -20°C or below. Samples should be shipped frozen on dry ice by an overnight courier in water-tight primary containers and leak-proof secondary containers that meet

the guidelines of the International Air Transport Association. The rabies laboratory at CDC should be telephoned (404-639-1050) at the time of shipment and given information on the mode of shipment, expected arrival time, and courier tracking number.

All four samples listed below are required to provide an antemortem rule out of rabies. A rule-out can not be provided if all samples are not collected. Use appropriate personal protection during specimen collection.

a. **Saliva**

Using a sterile eyedropper pipette, collect saliva and place in a small sterile container which can be sealed securely. No preservatives or additional material should be added. Laboratory tests to be performed include detection of rabies RNA (by reverse transcription and polymerase chain reaction, RT/PCR, of extracted nucleic acids) and isolation of infectious virus in cell culture. Tracheal aspirates and sputum are not suitable for rabies tests.

b. **Neck Biopsy**

A section of skin 5 to 6 mm in diameter should be taken from the posterior region of the neck at the hairline. The biopsy specimen should contain a minimum of 10 hair follicles and be of sufficient depth to include the cutaneous nerves at the base of the follicle. Place the specimen on a piece of sterile gauze moistened with sterile water and place in a sealed container. Do not add preservatives or additional fluids. Laboratory tests to be performed include RT/PCR and immunofluorescent staining for viral antigen in frozen sections of the biopsy.

c. **Serum and cerebral spinal fluid (CSF)**

At least 0.5 ml each of serum and CSF should be collected; no preservatives should be added. Do not send whole blood. If no vaccine or rabies immune serum has been given, the presence of antibody to rabies virus in the serum is diagnostic and tests of CSF are unnecessary. Antibody to rabies virus in the CSF, regardless of the immunization history, suggests a rabies virus infection. Laboratory tests for antibody include indirect immunofluorescence and virus neutralization.

Brain biopsy

The rarity of rabies and the lack of an effective treatment make the collection of a brain biopsy for antemortem testing unwarranted; however, biopsy samples negative for herpes encephalitis should be tested for evidence of rabies infection. The biopsy is placed in a sterile sealed container; do not add preservatives or additional fluids. Laboratory tests to be performed include RT/PCR and immunofluorescent staining for viral antigen in touch impressions.

3. Postmortem Samples

In certain cases, human samples may need to be tested for rabies postmortem. Consult with Communicable Disease Epidemiology Section before shipping any samples to the Rabies Laboratory at the CDC. Fresh tissue samples from the central nervous system (brain) should be submitted.

Postmortem diagnosis of rabies is made by immunofluorescent staining of viral antigen in touch impressions of brain tissue. Portions of the medulla (brain stem), the cerebellum, and the hippocampus should be frozen and shipped on dry ice to a public health laboratory or the CDC laboratory. Preservation of tissues by fixation in formalin is not recommended if rabies diagnosis is desired.

5. ROUTINE CASE INVESTIGATION

Interview the case and others who might provide pertinent information.

A. Evaluate the Diagnosis

Interview the health care provider and/or family member to collect clinical information. Review laboratory testing to date. Since testing at the CDC is always recommended, facilitate the collection and shipping of appropriate specimens to CDC.

B. Identify Source of Infection

Ask about animal bite and exposure history during the exposure period (years). If the animal is still available for testing, arrange to send it to Public Health Laboratories.

C. Identify Potentially Exposed Persons

Identify persons who may have been exposed to the patient and others who may have been exposed to the same source as the patient. It may be appropriate for these people to begin post-exposure prophylaxis.

6. CONTROLLING FURTHER SPREAD

A. Infection Control Recommendations

Staff should wear gowns, goggles, masks, and gloves, particularly during intubation and suctioning (MMWR 2008;57:RR-3).

B. Management of Other Persons Exposed

Although person-to-person transmission of rabies by bite has never been confirmed, rabies post-exposure prophylaxis (PEP) is recommended for persons who have exposure to a human with rabies. "Postexposure prophylaxis is indicated only when the patient has bitten another person or when the patient's saliva or other potentially infectious material such as neural tissue has contaminated an open wound or mucous membrane (MMWR 2008;57:RR-3)." Consult with CDES regarding PEP of persons exposed to a human with rabies. PEP should also be recommended to persons who have been exposed to the same source as the patient.

For more information on post-exposure prophylaxis, please see the Surveillance and Reporting Guidelines for Animal Bites and Rabies Post-Exposure Prophylaxis found at: http://www.doh.wa.gov/notify/guidelines/pdf/rabiesPEP.pdf

7. MANAGING SPECIAL SITUATIONS

N/A

8. ROUTINE PREVENTION

A. Human Pre-exposure Immunization

Rabies pre-exposure vaccinations are administered to individuals such as laboratory workers testing for rabies virus, veterinarians and their staff, wildlife biologists, rehabilitators, animal control officers who routinely have contact with stray domestic, exotic, and/or wild animals, and travelers having exposure risk for prolonged periods in rabies enzootic areas where medical care may be difficult to obtain. Pre-exposure immunization consists of three cell culture rabies vaccinations given on days 0, 7, and 21 or 28. For information regarding checking rabies titers, see the most current ACIP recommendations (MMWR 2008;57:RR-3).

B. Prevention Recommendations

1. Be a responsible pet owner:

- Keep vaccinations up-to-date for all dogs, cats and ferrets. This is important not only to keep your pets from getting rabies, but also to provide a barrier of protection to you, if your animal is bitten by a rabid wild animal.
- Keep your pets under direct supervision so they do not come in contact with wild animals. If your pet is bitten by a wild animal, seek veterinary assistance for the animal immediately.
- Call your local animal control agency to remove any stray pets from your neighborhood. They may be unvaccinated and could be infected by the disease.
- Spay or neuter your pets to help reduce the number of unwanted pets that may not be properly cared for or regularly vaccinated.

2. Avoid direct contact with unfamiliar animals

- Enjoy wild animals (raccoons, skunks, foxes) from afar. **Do not** handle, feed, or unintentionally attract wild animals with open garbage cans or litter.
- **Never** adopt wild animals or bring them into your home. **Do not** try to nurse sick wild animals. Call animal control or a wildlife rescue agency for assistance. In Washington it is illegal to own certain species of wild animals.
- Teach children **never** to handle unfamiliar animals, wild or domestic, even if they appear friendly. "Love your own, leave other animals alone" is a good principle for children to learn.
- Prevent bats from entering living quarters or occupied spaces in homes, churches, schools, or other similar areas, where they might come in contact with people or pets.
- When traveling abroad, avoid direct contact with wild animals and be especially careful around dogs in developing countries. Rabies is common in developing countries in Asia, Africa, and Latin America where dogs are the major reservoir of rabies. Before traveling abroad, consult with a health care provider, travel clinic, or your health department about the risk of exposure to rabies, appropriateness of pre-exposure prophylaxis, and how you should handle an exposure, should it arise.

3. Keep bats out of your home

Some bats live in buildings, and there may be no reason to evict them if there is little chance for contact with people. However, bats should always be prevented from entering rooms of your home. For assistance with "bat-proofing" your home, contact an animal-control or wildlife conservation agency. If you choose to do the "bat-proofing" yourself, here are some suggestions.

- Carefully examine your home for holes that might allow bats entry into your living quarters. Any openings larger than a quarter-inch by a half-inch should be caulked.
- Use window screens, chimney caps, and draft-guards beneath doors to attics, fill electrical and plumbing holes with stainless steel wool or caulking, and ensure that all doors to the outside close tightly.
- Additional "bat-proofing" can prevent bats from roosting in attics or buildings by covering outside entry points. Observe where the bats exit at dusk and exclude them by loosely hanging clear plastic sheeting or bird netting over these areas. Bats can crawl out and leave, but cannot re-enter. After the bats have been excluded, the openings can be permanently sealed.

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UPDATES

July 2008: Additional details were added to Sections 2H, 6A and 6B based on information in the most recent ACIP recommendations (MMWR 2008;57:RR-3).